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6. AUTHOR(S) LAWLESS, H.				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) ROCKY MOUNTAIN ARSENAL (CO.) COMMERCE CITY, CO			8. PERFORMING ORGANIZATION REPORT NUMBER  81356R69	
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13. ABSTRACT (Maximum 200 words)  SEVEN EXPERIMENTS WERE CONDUCTED UNDER THE OBJECTIVE OF TESTING OF PRECIPITATE FORMATION EFFICIENCY OF AIR, OXYGEN, AND OXYGEN OZONE; ESTIMATE THE TURBIDITY PRODUCED BY OZONATION OF THE SUPERNATANT OR FILTRATE. HYDROGEN PEROXIDE WAS INCLUDED IN SOME SMALL SCALE EXPERIMENTS. INCLUDED WITH THE REPORT IS A CHART ON THE SCHEDULE FOR PROCESS DEVELOPMENT, SOURCE TREATMENT SYSTEM DEVELOPMENT AND ANOTHER GRAPH ENTITLED MANGANESE HYDROXIDE SEDIMENTATION AT 640 F AND PH10, WELL 118 WATER CARBON TREATED.				
<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="font-size: 2em; font-weight: bold;">19950130 084</div> <div style="text-align: right;">DTIC QUALITY INSPECTED 3</div> </div>				
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PROGRESS REPORT

ORIGINAL  
81356R69

WORK STATEMENT OF JAN 1978 FOR RESEARCH SERVICES

CONTAMINATION CONTROL DIRECTORATE  
Rocky Mountain Arsenal  
Commerce City, Colorado 80022

81356R69  
original

Research Services for

Waterways Experiment Station  
Vicksburg, Mississippi 39180

Supporting Program Under ITARMS Task No. 1.05.11

Consisting of

Design of the Precipitation and Sedimentation Stage for Conditioning Water  
from Well 118 Prior to UV Ozonation

(See Test Plan Dated January 1978 for ITARMS Task No. 1.05.11 by Waterways  
Experiment Station)

March 1978

H. L. Lawless, Process Development & Evaluation, RMA

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## PROGRESS REPORT

### METHODOLOGY:

Objective 1. is the testing of precipitate formation efficiency of air, oxygen, and oxygen ozone; estimate the turbidity produced by ozonation of the supernatant or filtrate. Hydrogen peroxide was included in some small scale experiments.

Under objective 1 - The following experiments have been conducted:

Experiment No. 1: Estimate of time to saturate tap water in settling tank with air:

A plastic reactor .706 ft<sup>2</sup> by 5 ft high was equipped with air pump and three diffusers. Nitrogen was bubbled through the diffusers for 4 hours. Air was then pumped through the diffusers at 4.8 ft<sup>3</sup>/min (measured at 62°F and 628 mm over water as it discharged from the reactor vent). Flow/ft<sup>2</sup> is 6.8 ft<sup>3</sup>/(hr-ft<sup>2</sup> of surface).

#### DATA FROM EXPERIMENT NO. 1

<u>Sample No.</u>	<u>Dissolved Oxygen (ppm)</u>	<u>Elapsed Hours</u>	<u>Reactor Temp</u>	<u>Gas Sweep</u>
7	6.6	0	0	--
1	1.6	4	54°F	4 Hrs N <sub>2</sub>
2	7.3	0.25	62°F	Air
3	7.8	0.75	62°F	Air
4	7.8	1.25	62°F	Air
5	7.8	1.75	62°F	Air
6	7.7	2.75	62°F	Air

### CONCLUSION:

Reactor was saturated with oxygen in 15 minutes. Pump has adequate flow rate.

Experiment No. 2: Estimate effect of temperature, pH, and % Hydrogen Peroxide (HP) on dependent variables below. Reasoning is that aeration would volatilize a significant quantity of organics contained in Well 118 water while HP oxidation would avoid the problem.

DATA FROM EXPERIMENT 2 (5 DAYS RUN TIME)

	50°F				150°F			
	pH=7.6		pH=10.6		pH=7.0		pH=10.8	
	0% HP	.05% HP	0% HP	.05% HP	0% HP	.05% HP	0% HP	.05% HP
Y <sub>1</sub> =Filterable Res. (%)	.978	.946	.882	.879	.935	.914	.930	.907
Y <sub>2</sub> =Non-Filterable Res. (ppm)	70	80	2160	2080	380	460	3140	3020
Y <sub>3</sub> =Iron (ppm)	0.22	.05	.05	.05	.11	.073	.073	.068
Y <sub>4</sub> =Manganese (ppm)	34.6	27.2	0.13	.05	2.03	2.38	.05	.05
Y <sub>5</sub> =% HP	.001	.001	.001	.001	.001	.001	.001	.001
Y <sub>6</sub> =Extractable Organics (ppm)	22.2	24.4	12.9	19.2	12.1	16.5	8.6	11.6

Conclusions will be based on statistical analysis of the data. In general:

1. Iron was low in well water at 50°F, 0% HP, and pH 7.6. Air cushion in well tank may be responsible; nitrogen cushion being placed in tank.
2. Manganese is precipitated at higher pH; HP has some effect and heat aids precipitation.
3. Extractable organics show complex behavior but there is little indication of organics destruction by HP.

Experiment No. 3:

3-A Testing effect of nitrogen on volatilization of organics, filterable solids, and on iron and manganese precipitation. (The Fe/Mn data will be the baseline for aeration experiments).

3-B Aeration experiments using nitrogen treated Well 118 water -- measure loss of organics due to oxidation and precipitation of iron/manganese.

Samples in for analysis.

Experiment No. 4:

Oxygenation of above aerated water to compare air and oxygen.

Samples in for analysis.

Experiment No. 5:

Removed organic material from Well 118 water with activated carbon column.

Aerated and sampled to estimate iron, Mn, COD, and insolubles. Loss across carbon bed is to be estimated.

Samples in for analysis.

Experiment No. 6:

Oxygenation of water left from Experiment No. 5 (little or no precipitation seen).

Samples in for analysis.

Experiment No. 7:

Precipitation of manganese by increasing pH to 9.5. Will get preliminary sedimentation rate data from this.

This experiment is in progress.

Future experiments will involve ozone rather than air or oxygen. Want to avoid pH adjustment if possible. Will repeat some of above experiments. Sedimentation rate of ozone-formed precipitate will be measured.

## 2 Feb 78

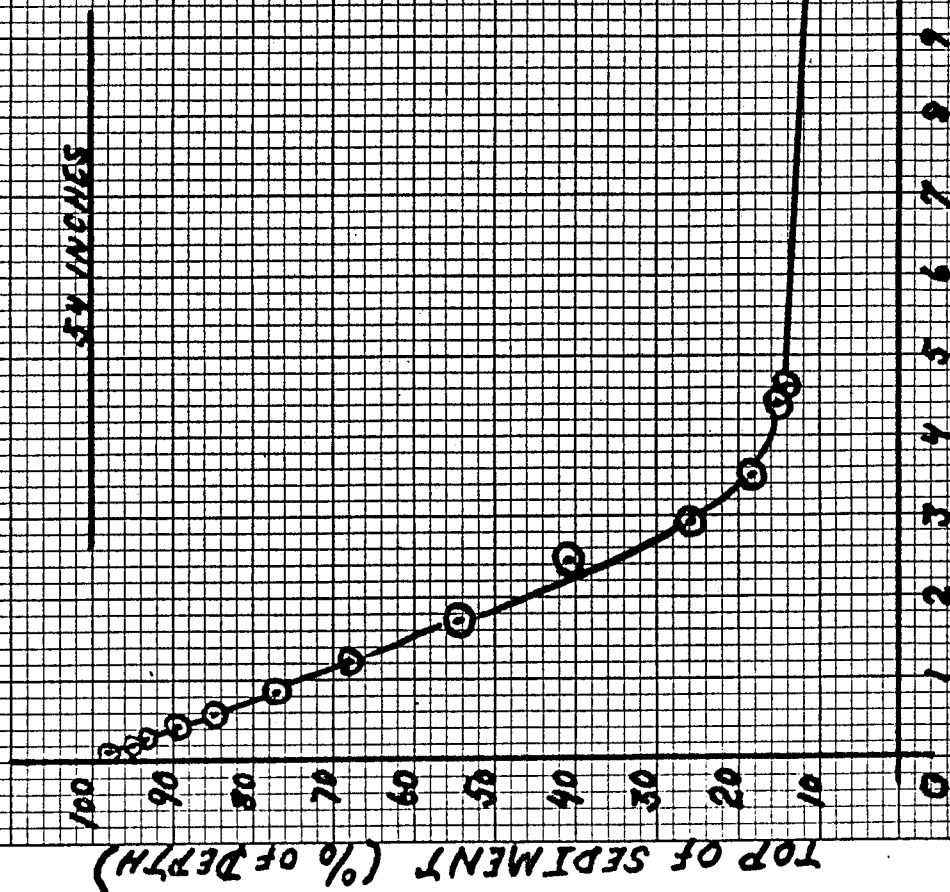
#### 4.4.3 Basic Cost Data

FIG. I

15 MAR 1978

MANGANESE HYDROXIDE SEDIMENTATION AT 69°F AND PH 10

WELL 118 WATER CARBON TREATED



NOTE: WATER ABOVE TOP OF SEDIMENT  
WAS CRYSTAL CLEAR

HOURS SEDIMENTATION

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